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IMAGINGS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	140
IMAGED.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	54236
IMAGEDS	0
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Search History

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Search Results - Record(s) 1 through 4 of 4 returned.

☐ 1. Document ID: US 20020165549 A1

L9: Entry 1 of 4 File: PGPB Nov 7, 2002

PGPUB-DOCUMENT-NUMBER: 20020165549
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020165549 A1

TITLE: Surgical instrument and attachment

PUBLICATION-DATE: November 7, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Owusu-Akyaw, Samuel	Southlake	TX	US	
Ellins, Rob	Euless	TX	US	
Henderson, John K.	Flower Mound	TX	US	
Strauss, E. Paul	Grapevine	TX	US	
Williams, Keith	Memphis	TN	US	
Schenk,, Raymond Lyle III	Chanhassen	MN	US	
Hilton, Allen P.	Arlington	TX	US	
Highley, Brian	Keller	TX	US	
Busker, Michael John	Oakdale	MN	US	
Lundeen, Steven John	Ramsey	MN	US	
Serre, Mark A.	Burns Township	MN	US	
Quiring, Curtis Wayne	Anoka	MN	US	
Clem, Bryan Michael	Mound	MN	US	
Wilson, Richard Dennis	St. Francis	MN	US	

US-CL-CURRENT: 606/80

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw Desc | Image

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☐ 2. Document ID: US 20020135370 A1

L9: Entry 2 of 4 File: PGPB Sep 26, 2002

PGPUB-DOCUMENT-NUMBER: 20020135370
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020135370 A1

TITLE: Air feed device, signal acquisition device and imaging device

PUBLICATION-DATE: September 26, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Kan, Koji	Tokyo		JP	

US-CL-CURRENT: 324/318; 324/306

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC
Draw Desc | Image

3. Document ID: US 20020061982 A1

L9: Entry 3 of 4 File: PGPB May 23, 2002

PGPUB-DOCUMENT-NUMBER: 20020061982
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020061982 A1

TITLE: Compositions comprising hydrogenated block copolymers and end-use applications thereof

PUBLICATION-DATE: May 23, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Donald, Robert J.	Midland	MI	US	
Hahnfeld, Jerry L.	Midland	MI	US	
Parsons, Gary D.	Midland	MI	US	
Hahn, Stephen F.	Midland	MI	US	
Patel, Rajen M.	Lake Jackson	TX	US	
Esneault, Calvin P.	Baton Rouge	LA	US	
Phipps, Laura M.	Rochelle	VA	US	
Pate, James E. III	Sanford	MI	US	
Bhattacharjee, Debkumar	Lake Jackson	TX	US	

US-CL-CURRENT: 525/332.9; 525/338

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

4. Document ID: US 5485850 A

L9: Entry 4 of 4 File: USPT Jan 23, 1996

US-PAT-NO: 5485850
DOCUMENT-IDENTIFIER: US 5485850 A

TITLE: Monitor of low pressure intervals with control capabilities

DATE-ISSUED: January 23, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Dietz; Henry G.	Garden City	NY	11530	

US-CL-CURRENT: 600/529; 128/204.23, 73/861.44

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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Term	Documents
MAGNETIC.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1074536
MAGNETICS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	9761
RESONANCE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	205038
RESONANCES.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	11345
MRI.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	14364
MRIS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	132
NMR.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	102988
NMRS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	131
(8 AND (MRI OR (MAGNETIC ADJ RESONANCE) OR NMR)).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	4
(L8 AND ((MAGNETIC ADJ RESONANCE) OR MRI OR NMR)).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	4

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L9: Entry 4 of 4 File: USPT Jan 23, 1996

DOCUMENT-IDENTIFIER: US 5485850 A
TITLE: Monitor of low pressure intervals with control capabilities

Abstract Text (1):
A monitor that provides data obtained from the detection of very low positive, negative, or differential pressures, and can be used to control devices in health care and industry. An example of its use in health care is as a respiration monitor providing data that can be used to control devices associated with breathing while providing constant surveillance of the fundamental characteristics of air-breathing humans and animals. In industry it can act as a monitor that provides data by sensing very low pressures (negative, positive or differential) at intervals that can be used to detect positioning of low weight parts or act as a touch sensor for robotic equipment. Monitor detects pressure intervals by use of a vane type capacitance sensor capable of detecting pressures as low as 0.001 ounce per square inch. Monitor uses a micro-controller to control devices from data, obtained from sensor, by storing programs that govern, in predetermined manner, the operation of devices.

Brief Summary Text (5):
This made possible an inexpensive device that could detect when apnea occurred (failure to breath for 10 seconds or longer) and was suitable for use as a monitor for possible prevention of crib-death (SIDS). However, in use it was best if a filter was used to prevent the possibility of the graphite powder being ingested. This reduced the sensitivity and with the fact that the ball could last for approximately 100,000 operations (when it would require refurbishing) it was not too suitable for health care use. The device was found to be better suited for industrial use. Its industrial use is to detect airflow (example: act as a safety interlock switch to detect loss of airflow in air cooled electronic equipment) and other uses such as to detect the low pressure maintained in clean rooms to prevent the entrance of contaminated air. In industrial applications where the equipment had the switch working only when the equipment was turned on or off once a day, a life of 10,000 operations would be the normal requirement and the 100,000 operations of the plastic ball's operating life was extremely satisfactory. A filter is not required for industrial applications so the sensitivity is high.

Brief Summary Text (8):
The limited number of operations of the ball type sensor required that a more satisfactory sensor, with a longer operating life, be developed. This resulted in a sensor employing a diaphragm being created that detected the movement of the diaphragm by the use of optoelectronics. This device had excellent sensitivity and U.S. Pat. No. 4,745,925, May 24, 1988, was issued for this device. This device not only sensed the low negative pressure of inhalation, but eliminated the need for a filter, and had a life of over 10 million operations. The patent also described its use for inhalation therapy, where each time a breath is taken it triggers a dose of oxygen. The dose of oxygen was for a fixed period of time, adjusted manually. The use of intermittent flow of oxygen over the normal continuous flow can result in 50 to 70% savings in the cost of oxygen. This is possible since a human inhales approximately 30% of the time and exhales 70% of the time; 30% of the oxygen goes into the patient and the other 70% goes into the room and is wasted.

Brief Summary Text (10):
This led to a development of a mouth nose mask, U.S. Pat. No. 5,005,517--Apr. 9, 1991, that provided for diversion of some of the oral inhalation air to the nasal passageways where it could be sensed by a nasal cannula connected to the monitor employing the optoelectronic sensor.

Brief Summary Text (11):

U.S. Pat. No. 5,024,21[illegible] Jun. 18, 1991 shows how the ab[illegible] developed unit, U.S. Pat. No. 4,745,925--May 24, [illegible]88, can have multiple uses suc[illegible]s being used from four possible sources of supply; a large tank of breathable gas, a small tank of breathable gas, a wall outlet supplied from a bulk storage system of breathable gas, and an oxygen concentrator supplying oxygen from ambient air.

Brief Summary Text (12):
All of the above used a fixed dose of oxygen that had to be manually adjusted, U.S. Pat. No. 5,038,771--Aug. 13, 1991 was issued for a new developed method where the dose of oxygen was determined by taking a percentage of a previous breath, thus automatically adjusting to a rate of breathing of air-breathing animals, including humans.

Brief Summary Text (15):
The experience gained from the development of the above products resulted in an effort to develop a device that would have greater sensitivity, lower cost, unlimited control capabilities, longer life, smaller size, and the ability to be programmed to the special requirements of an unlimited number of applications. This resulted in the development of the monitor for low pressure intervals with control capabilities as explained in the summary of this invention, that can do all the past functions and many new sophisticated functions because it is software controlled. It also employs a newly developed vane type sensor that is more sensitive, smaller size, and less costly to manufacture.

Brief Summary Text (16):
When used as a medical device for inhalation therapy, it provides for an intermittent flow of oxygen to save cost while being clinically equivalent to continuous flow now in use. It also provides for a higher quality health care because it can signal if the patient is not receiving the benefit of the therapy.

Brief Summary Text (19):
Its operation is dependent on detecting the negative pressure present at the nasal cavities when inhalation occurs. This negative pressure can be of a very low value when the air-breathing human is breathing through his mouth.

Brief Summary Text (20):
It is possible to obtain sufficient negative pressure that the invention can monitor, by using the common nasal cannula used for administering gaseous fluids when the patient breaths through his nose. However, when the patient breaths through his mouth, this lower negative pressure makes it almost impossible to detect the onset of inhalation at the nasal cavities.

Brief Summary Text (21):
To overcome this problem, a mouth-nose mask was developed, described in U.S. Pat. No. 5,005,571. This mouth-nose mask provided for the diversion of some of the oral inhalation air to the nasal cannula to sense inhalation.

Brief Summary Text (22):
The use of this mouth-nose mask, with the nasal cannula used for administration of gaseous fluids, provided for successfully sensing the negative pressure of inhalation when the patient breathed through his mouth. However, it was uncomfortable to wear compared to the simple nasal cannula. Therefore, a special nasal cannula was developed for the purpose of sensing respiration. This nasal cannula provided for a much lower impedance to the flow of negative pressure from the nasal passageways.

Brief Summary Text (27):
Air-breathing humans inhale approximately 30% of the time and exhale approximately 70% of the time. Therefore, 30% of the inhalation gas goes into the patient and the other 70% goes into the environment and is wasted because there is a continuous flow of the therapeutic gas in present day systems.

Brief Summary Text (30):
The therapy given by this use of the invention results in an intermittent flow of the therapeutic gas that is clinically equivalent to the continuous flow systems now in use.

Brief Summary Text (34):
When the invention is used only as a respiration monitor, it has the advantage of no electrical connections to the patient. The only connection to the patient is the air tubing connecting the two prongs in the nasal cannula (for detecting the negative pressure of inhalation) to the input connection of the monitor. Therefore, it is impossible to have any electrical hazard to the patient. Thus, the monitor can be

used with magnetic resonance imaging, to detect respiration, where there can be no electrical wiring to the patient.

Brief Summary Text (37):
The unit described for inhalation therapy can also be used for administering air from air tanks used by firemen, pilots and passengers flying in private aircraft above 14,000 feet, and by people in areas subject to extremes of air pollution. An air tank that holds 400 liters of air, which was being used at 2 liters per minute, would last for 200 minutes, but by using the invention would last for 10 hours.

Brief Summary Text (39):
Using the monitor for general care does not necessitate that it be delivering a gaseous fluid, for when used in this manner, a very small blower having a pressure of 0.1 ounce per square inch, will allow it to be used simply as a respiration monitor.

Brief Summary Text (42):
A unit having the functions previously described for inhalation therapy can also be used for the administration of anesthesia gaseous fluid. Often when nitrous oxide (laughing gas) is being administered to a patient having dental work done, a loose fitting mask can cause a loss of the gas into the environment. Studies disclosed when this leaking gas is inhaled by people working with the patient it can have disastrous effects on pregnant women and lower the sperm count of men, making it more difficult to create offspring. Since the invention would administer the nitrous oxide only when the patient inhales, the loss of the anesthesia into the environment is prevented.

Brief Summary Text (49):
The position or presence of a chip can be determined by drilling a small hole on the surface on which it is resting. To this small hole a connection is made with tubing to a "T" connection. One connection to the "T" is a low negative pressure obtained from a very small brushless blower. A second connection is made to the drilled hole, and the third connection goes to the inlet connection to the input of the monitor. When the part covers the hole, a negative pressure actuates the sensor (by moving the vane of the capacitance sensor from the normal position.) When this occurs, a positive pressure enters the sensor and the vane is returned to its normal position ready to detect if there is again a negative pressure indicating if a part is there. If no negative pressure is present, the micro-controller chip can be set to give a signal indicating there is no chip present or in position to close up the hole.

Drawing Description Text (7):
FIG. 5--is a diagrammatic view of the vane type capacitance sensor, with it's aluminum block shown by A--A cutaway to expose the vane actuated by the negative pressure of inhalation.

Drawing Description Text (15):
FIG. 13--is a diagrammatic view of how the monitor is connected to dispense drugs by use of a nebulizer, how it can be used with a humidifier, and how it can be used with anesthesia gaseous fluids.

Detailed Description Text (9):
The monitor described in this embodiment has full clinical equivalency to the present method of continuous flow, but due to the fact that it provides for intermittent flow determined by a patient's breathing, it can save 50% to 70% of the cost of oxygen.

Detailed Description Text (18):
The monitor is connected by tube 3, FIG. 3, to an adjusted regulated flow of oxygen (such as 2 liters per minute) from a tank, oxygen concentrator, or a wall outlet in a hospital using a fixed regulator, to obtain a fixed pressure of 20 or 50 pounds per square inch, and a second regulator adjustable to zero pounds per square inch.

Detailed Description Text (19):
Before powering up the monitor, it is necessary for the flow of oxygen to be adjusted to the desired flow rate at the source of supply. Oxygen will then pass through the monitor as a continuous flow directly from tube 3, FIG. 3 to outlet connector 2, FIG. 2, through nasal cannula 1, FIG. 3, that supplies oxygen to a patient.

Detailed Description Text (20):
Powering up the monitor by pressing switch 4, FIG. 2, to an "on" position will turn an apparatus "on", which will be verified by digital display 5, FIG. 2, being illuminated. Immediately flow of oxygen from connection 2, FIG. 2, will be stopped

by the monitor, and no oxygen will flow from outlet connection 2. To obtain a flow of oxygen from outlet connection 2, a negative pressure must be detected from the first three breaths of a patient wearing the nasal cannula.

Detailed Description Text (23):
The LED (light emitting diode) 6, FIG. 2, marked "Dose" will indicate when oxygen flows. The monitor is always shipped prepared for automatic operation. Other modes of operation should be made only by an authorized service representative upon the request of a licensed physician.

Detailed Description Text (30):
FIG. 5 is a cutaway isometric drawing of the sensor. A standard 1/4" pipe thread 11, FIG. 5, is shown cutaway through its center located in an aluminum block 12. Into this threaded pipe hole is inserted connector 2, FIG. 2, used for connecting the monitor to the patient's cannula 1, FIG. 3. When a patient inhales, a negative pressure occurs at the small hole opening 13, FIG. 5. This negative pressure causes a 0.0003" aluminum coated mylar vane 14, FIG. 5 to be sucked up and hit the bent up portion of the two hole clamping bracket 15, FIG. 5. Vane 14 has its aluminum coated side facing upward and its insulated side adjacent to copper foil 17, FIG. 6, outlined with a dotted line on a printed circuit board 16, FIG. 6. FIG. 5 shows the printed circuit board 16 facing up and FIG. 6 shows the bottom of board 16. The two plate capacitor is formed by vane 14 and copper foil 17 with the dielectric being the 0.0003" thick mylar. Vane 14 can be sucked upward because there are 9 holes, 18, FIG. 6, under vane 14 to allow atmospheric pressure to force vane 14 upward when there is a negative pressure at hole 13.

Detailed Description Text (31):
Electrical connection 19, FIG. 6, is made by clamp 15 clamping vane 14.

Detailed Description Text (32):
Electrical connection 20 is made by a wire soldered to copper foil 17. These two electrical connections make vane 14 a variable capacitor whose operation is dependent upon the inhalation of patient wearing nasal cannula 1. The value of capacitor is inversely proportional to the distance between the two plates and has a value in the pico-farad range. Voltage applied to this capacitor is kept constant. The change in charge is determined by the position of vane 14 relative to copper foil 17.

Detailed Description Text (42):
In order to control the flow of oxygen for a duration of time, an oxygen valve is used which is opened and closed by using internal solenoid 65. A solenoid is a power consuming element. It takes more power to activate a solenoid than it does to keep it energized. Once it is energized it takes 3 to 4 times less power to keep it energized. In monitor, chip 66, along with components capacitance 67, resistors 68 and 69, capacitance 70 and 71, zener diode 72, and darlington transistor 73, are incorporated to reduce the total power consumption by the solenoid 65 as shown in FIG. 10.

Detailed Description Text (48):
FIG. 11 shows how sensor 16 is used for respiratory therapy. Cannula 1, commonly available in hospitals for administering oxygen, is used to connect the flow of oxygen from a user's nostrils to sensor 16 by means of connector 2.

Detailed Description Text (49):
Tubing 87 connects to connector 88 which is internally connected to sensor 16 and provides a positive pressure to return vane 14 to its original position after an inhalation occurs.

Detailed Description Text (50):
The other end of tubing 87 is connected to valve 65. Valve 65 is normally open, so if power fails oxygen will flow continuously. The one unused outlet is sealed close. Tube 89 connects valve 65 to panel connector 86, which is located on rear panel of the monitor. Tube 3 goes from connector 86 to the source of regulated flowing oxygen.

Detailed Description Text (62):
The first inhalation is not displayed on the screen. The second inhalation is the first one displayed on the screen with A:0 (no flow of oxygen). The oxygen dose for the third inhalation shown as the second line above is 200 mS and this is always a constant time. The future oxygen dose is calculated by taking the expected breath and multiplying it by 30% (the mode selected.) If the result is less than 200 mS, the oxygen dose will be increased to 200 mS. If the calculated dose is greater than 200 mS the oxygen will be the calculated value.

Detailed Description Text (65):
While the invention has been particularly shown and described with references to the preferred embodiments thereof, it will be understood by those skilled in the art that various alterations in form and detail may be made therein without departing from the spirit and scope of the invention. For example, where use with oxygen is described, it should be understood that any gaseous fluid, such as air, or anesthesia gaseous fluids can be substituted.

Detailed Description Text (66):
Moreover, while the invention has been particularly shown and described for clinical use (as with human patient, for example), it should be understood the invention may be used in conjunction with gaseous fluid supply for not only administering such gaseous fluids, but can also contain a small self-contained DC brushless motor to supply the positive pressure needed to activate the sensor vane back to its normal position. The sensor can be activated by negative, positive, or differential pressure. It should be understood that the invention can be used to monitor controlling administration of gaseous fluids, sending out data, controlling alarms (such as when apnea occurs), controlling the delivery of continuous positive airway pressure in the above, and in a subject in industrial, polluted areas, aeronautical, subterranean, or underwater environments.

Detailed Description Text (69):
When the invention is used only as a respiration monitor, it is necessary to only replace the oxygen supply with a DC brushless motor connected to incoming DC voltage, and using the air pressure from this blower to replace the oxygen supply.

Detailed Description Text (74):
To use the preferred embodiment for inhalation drugs, either an oxygen supply, air from an air compressor, or other source may be directed into the same input connection for the supply selected. The nasal cannula is only connected to the sensor and the oxygen or air would not be connected to the sensor, but go directly from the output tube 101, FIG. 13 of valve 65 to nebulizer 102.

Detailed Description Text (75):
FIG. 13 shows how the monitor is connected when it is used to dispense drugs by use of a nebulizer. Nasal cannula 1 senses the onset of inhalation and triggers a dose of either compressed air or oxygen supplied by tube 3. The small low DC voltage blower 100 replaces the pressure normally supplied by the therapeutic gas (such as oxygen) that is used to return vane 14, FIG. 5 in sensor 12 to its normal position for maximum capacitance after inhalation takes place. The nebulizer atomizes only during the time patient is inhaling, and therefore no drug is atomized when the patient is exhaling; and accurately controls the amount of drug inhaled by the patient. The solenoid valve 120 is wired in parallel to solenoid valve 65. Pressure connection 122, receiving pressure from blower 100, goes through solenoid valve 120 and then through tube 123 to sensor 12.

Detailed Description Text (76):
Administration of anesthesia gaseous fluids can be performed in an identical fashion. Also where an anesthesia gas, such as nitric oxide is used, it can be supplied to tube 3 and delivered to the patient by a mouthpiece replacing nebulizer 102.

Detailed Description Text (79):
Administration of anesthesia gaseous fluid can be performed with the unit shown in FIG. 13 in the same manner as oxygen is administered.

Detailed Description Text (85):
The invention can be used as a control for ventilators that employ PEEP (positive end expiratory pressure) requiring the negative inhalation pressure be sensed when there is positive air pressure being delivered during exhalation. FIG. 17 is a diagrammatic view of how the monitor can be used to control ventilators employing a low positive airway pressure during exhalation, which is increased to a high positive pressure when inhalation takes place. The patient wears nasal cannula 132, FIG. 17, which is connected to sensor 12, chamber 133 for use in detecting the negative pressure of inhalation. Mask 131, worn over the nasal cannula, covers the nose and mouth, with connection tube 135 going to valve 136 which has an electrically operated hinged vane 130 that can select one of the two sources of positive airway pressure (128, 129). A tube goes from mask 131 to connection 126 on the electrically operated solenoid valve 125; connection 127 of solenoid valve 125 is connected to chamber 134.

Detailed Description Text (86):

The theory of operatio[illegible]s that sensor 14, 15, and 16 a[illegible] as a differential pressure switch with i[illegible] reference pressure in chamber [illegible] being supplied by low positive airway pressure source 128. When the devices are first turned on the pressure in chamber 133 is equal to the pressure in chamber 134 because the connection is made from mask 131 (which has the low positive airway pressure) to the electrically operated solenoid valve 125 that is open to allow the low positive airway pressure to enter chamber 134. When the patient inhales a negative pressure is present at the nasal cavities, and this results in vane 14 moving away from printed circuit board 16. As described in the preferred embodiment this results in a signal being sent to the microprocessor. This signal results in solenoid valve 125 being closed and in vane 130 of valve 136 being electrically moved to a new position, shutting off the low positive airway pressure source 128, and sending the high positive airway pressure of source 129 to mask 131 where it inflates the lung cavities. Vane 14 is then subject to the high positive airway pressure source 129, and is returned to its original position adjacent to printed circuit board 16. Pressure from the high positive airway pressure is applied for the period of inhalation as described in the preferred embodiment. At the end of the dose, valve 130 is moved to deliver only the low positive airway pressure to mask 131, and valve 125 is again open to deliver the low positive airway pressure and have chamber 134 pressure equal to pressure in chamber 133.

CLAIMS:

1. An apparatus for monitoring low pressure intervals and controlling delivery of therapeutic gas to be synchronous with inhalation comprising:

a) a source of therapeutic gas;

b) means for delivering the therapeutic gas from the source to nasal cavities of an air breathing animal;

c) sensing means, connected to the means for delivering, for generating a signal indicative of a change in pressure produced at a beginning of inhalation of the air breathing animal, said sensing means including a vane;

d) processing means for receiving the signal and determining a length of inhalation of the animal, said processing means including circuit means for determining a dose of the therapeutic gas to be delivered to the animal, the circuit means including means for automatically adjusting a length of the dose to be a percentage of the length of the inhalation of the animal with the length of the dose never less than 200 mS;

e) means for controlling delivery of the dose of therapeutic gas; and

f) alarm means for generating an alarm when the sensing means does not generate the signal for a predetermined time period.

2. The apparatus as set forth in claim 1, having means for controlling delivery of the dose of therapeutic gas wherein:

said means for delivering includes a valve to obtain a controllable flow; and

means for reducing electrical power requirements by reducing power input to said valve immediately after said valve is actuated to obtain longer battery life.

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1. Document ID: US 20020165549 A1

L10: Entry 1 of 3 File: PGPB Nov 7, 2002

PGPUB-DOCUMENT-NUMBER: 20020165549
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020165549 A1

TITLE: Surgical instrument and attachment

PUBLICATION-DATE: November 7, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Owusu-Akyaw, Samuel	Southlake	TX	US	
Ellins, Rob	Euless	TX	US	
Henderson, John K.	Flower Mound	TX	US	
Strauss, E. Paul	Grapevine	TX	US	
Williams, Keith	Memphis	TN	US	
Schenk,, Raymond Lyle III	Chanhassen	MN	US	
Hilton, Allen P.	Arlington	TX	US	
Highley, Brian	Keller	TX	US	
Busker, Michael John	Oakdale	MN	US	
Lundeen, Steven John	Ramsey	MN	US	
Serre, Mark A.	Burns Township	MN	US	
Quiring, Curtis Wayne	Anoka	MN	US	
Clem, Bryan Michael	Mound	MN	US	
Wilson, Richard Dennis	St. Francis	MN	US	

US-CL-CURRENT: 606/80

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw. Desc | Image

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2. Document ID: US 20020135370 A1

L10: Entry 2 of 3 File: PGPB Sep 26, 2002

PGPUB-DOCUMENT-NUMBER: 20020135370
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020135370 A1

TITLE: Air feed device, signal acquisition device and imaging device

PUBLICATION-DATE: September 26, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Kan, Koji	Tokyo		JP	

US-CL-CURRENT: 324/318; 324/306

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

3. Document ID: US 5485850 A

L10: Entry 3 of 3 File: USPT Jan 23, 1996

US-PAT-NO: 5485850
DOCUMENT-IDENTIFIER: US 5485850 A

TITLE: Monitor of low pressure intervals with control capabilities

DATE-ISSUED: January 23, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Dietz; Henry G.	Garden City	NY	11530	

US-CL-CURRENT: 600/529; 128/204.23, 73/861.44

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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Term	Documents
IMAGE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1982646
IMAGES.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	389889
IMAGING.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	184110
IMAGINGS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	140
IMAGED.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	54236
IMAGEDS	0
(9 AND (IMAGED OR IMAGING OR IMAGE)).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	3
(L9 AND (IMAGE OR IMAGING OR IMAGED)).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	3

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Search Results - Record(s) 1 through 2 of 2 returned.

☐ 1. Document ID: US 20020165549 A1

L12: Entry 1 of 2 File: PGPB Nov 7, 2002

PGPUB-DOCUMENT-NUMBER: 20020165549
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020165549 A1

TITLE: Surgical instrument and attachment

PUBLICATION-DATE: November 7, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Owusu-Akyaw, Samuel	Southlake	TX	US	
Ellins, Rob	Euless	TX	US	
Henderson, John K.	Flower Mound	TX	US	
Strauss, E. Paul	Grapevine	TX	US	
Williams, Keith	Memphis	TN	US	
Schenk,, Raymond Lyle III	Chanhassen	MN	US	
Hilton, Allen P.	Arlington	TX	US	
Highley, Brian	Keller	TX	US	
Busker, Michael John	Oakdale	MN	US	
Lundeen, Steven John	Ramsey	MN	US	
Serre, Mark A.	Burns Township	MN	US	
Quiring, Curtis Wayne	Anoka	MN	US	
Clem, Bryan Michael	Mound	MN	US	
Wilson, Richard Dennis	St. Francis	MN	US	

US-CL-CURRENT: 606/80

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

☐ 2. Document ID: US 20020135370 A1

L12: Entry 2 of 2 File: PGPB Sep 26, 2002

PGPUB-DOCUMENT-NUMBER: 20020135370
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020135370 A1

TITLE: Air feed device, signal acquisition device and imaging device

PUBLICATION-DATE: September 26, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Kan, Koji	Tokyo		JP	

US-CL-CURRENT: 324/318; 324/306

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC

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Term	Documents
SUBJECT.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	813022
SUBJECTS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	62573
OBJECT.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	2286799
OBJECTS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1447875
PATIENT.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	299827
PATIENTS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	150632
(11 AND (SUBJECT OR PATIENT OR OBJECT)).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	2
(L11 AND (SUBJECT OR OBJECT OR PATIENT)).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	2

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Search Results - Record(s) 1 through 1 of 1 returned.

☐ 1. Document ID: US 20020135370 A1

L13: Entry 1 of 1 File: PGPB Sep 26, 2002

PGPUB-DOCUMENT-NUMBER: 20020135370
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020135370 A1

TITLE: Air feed device, signal acquisition device and imaging device

PUBLICATION-DATE: September 26, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Kan, Koji	Tokyo		JP	

US-CL-CURRENT: 324/318; 324/306

Full | Title | CIT 1 | REV 1 | CLS 1 | REF 1 | SEQ 1 | ATT 1 | RAW 1

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Term	Documents
COOL$5	0
COOL.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	272699
COOLA.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	16
COOLAANT.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1
COOLAB.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	2
COOLABAH.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	3
COOLABL.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1
COOLABLE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1646
COOLABLEE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1
COOLABLY.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	12
COOLABT.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1
(L12 AND (COOL$5)).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	1

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Search Results - Record(s) 1 through 24 of 24 returned.

☐ 1. Document ID: US 20020135370 A1

L20: Entry 1 of 24 File: PGPB Sep 26, 2002

PGPUB-DOCUMENT-NUMBER: 20020135370
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020135370 A1

TITLE: Air feed device, signal acquisition device and imaging device

PUBLICATION-DATE: September 26, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Kan, Koji	Tokyo		JP	

US-CL-CURRENT: 324/318; 324/306

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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☐ 2. Document ID: US 20020133886 A1

L20: Entry 2 of 24 File: PGPB Sep 26, 2002

PGPUB-DOCUMENT-NUMBER: 20020133886
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020133886 A1

TITLE: Washing apparatus

PUBLICATION-DATE: September 26, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Severns, John Cort	West Chester	OH	US	
Hartman, Frederick Anthony	Cincinnati	OH	US	
Laurent, James Charles Theophile Roger Burckett-St.	Hamilton	OH	US	
Noyes, Anna Vadimovna	Hamilton	OH	US	
Radomyselski, Arseni V.	West Chester	OH	US	
France, Paul Amaat	Loveland	OH	US	
Scheibel, Jeffrey John	West Chester	OH	US	
Thoen, Christiaan Arthur Jacques Kamiel	West Chester	OH	US	
Deak, John Christopher	Fairfield	OH	US	
Vinson, Phillip Kyle	Cincinnati	OH	US	
Sakkab, Nabil Yaqub			US	

US-CL-CURRENT: 8/142

☐ 3. Document ID: US 20020047071 A1

L20: Entry 3 of 24 File: PGPB Apr 25, 2002

PGPUB-DOCUMENT-NUMBER: 20020047071
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020047071 A1

TITLE: Lifting platform with energy recovery

PUBLICATION-DATE: April 25, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Illingworth, Lewis	Kensington	NH	US	

US-CL-CURRENT: 244/199

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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☐ 4. Document ID: US 20010040062 A1

L20: Entry 4 of 24 File: PGPB Nov 15, 2001

PGPUB-DOCUMENT-NUMBER: 20010040062
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20010040062 A1

TITLE: Lifting platform

PUBLICATION-DATE: November 15, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Illingworth, Lewis	Kensington	NH	US	

US-CL-CURRENT: 180/117; 416/185

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

☐ 5. Document ID: US 6464459 B2

L20: Entry 5 of 24 File: USPT Oct 15, 2002

US-PAT-NO: 6464459
DOCUMENT-IDENTIFIER: US 6464459 B2

TITLE: Lifting platform with energy recovery

DATE-ISSUED: October 15, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Illingworth; Lewis	Kensington	NH		

US-CL-CURRENT: 415/208.2; 180/122, 415/211.2

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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6. Document ID: US 6447583 B1

L20: Entry 6 of 24 File: USPT Sep 10, 2002

US-PAT-NO: 6447583
DOCUMENT-IDENTIFIER: US 6447583 B1

TITLE: Rotating drum adsorber process and system

DATE-ISSUED: September 10, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Thelen; John E.	Ocala	FL		
Peterson; Brian	Ocala	FL		
Thomson; Robert G.	Ocala	FL		

US-CL-CURRENT: 96/125; 95/113, 96/109, 96/130

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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7. Document ID: US 6257498 B1

L20: Entry 7 of 24 File: USPT Jul 10, 2001

US-PAT-NO: 6257498
DOCUMENT-IDENTIFIER: US 6257498 B1

TITLE: Method and apparatus for an agricultural air handler

DATE-ISSUED: July 10, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Siebol; James R.	Yakima	WA	98901	

US-CL-CURRENT: 239/77; 239/129, 239/135, 239/14.1, 239/165, 239/172, 239/78, 415/122.1, 415/126, 415/213.1, 416/171, 416/246, 47/2

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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8. Document ID: US 6192548 B1

L20: Entry 8 of 24 File: USPT Feb 27, 2001

US-PAT-NO: 6192548

DOCUMENT-IDENTIFIER: 6192548 B1

TITLE: Upright extraction cleaning machine with flow rate indicator

DATE-ISSUED: February 27, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Huffman; Eric C.	Lowell	MI		

US-CL-CURRENT: 15/320; 15/339

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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9. Document ID: US 5932940 A

L20: Entry 9 of 24 File: USPT Aug 3, 1999

US-PAT-NO: 5932940
DOCUMENT-IDENTIFIER: US 5932940 A

TITLE: Microturbomachinery

DATE-ISSUED: August 3, 1999

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Epstein; Alan H.	Lexington	MA		
Senturia; Stephen D.	Brookline	MA		
Waitz; Ian A.	Newton	MA		
Lang; Jeffrey H.	Sudbury	MA		
Jacobson; Stuart A.	Somerville	MA		
Ehrich; Fredric F.	Marblehead	MA		
Schmidt; Martin A.	Reading	MA		
Ananthasuresh; G. K.	Philadelphia	PA		
Spearing; Mark S.	Newton	MA		
Breuer; Kenneth S.	Newton	MA		
Nagle; Steven F.	Cambridge	MA		

US-CL-CURRENT: 310/40MM; 257/414, 257/415, 290/52, 60/39.35, 60/804

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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10. Document ID: US 5924286 A

L20: Entry 10 of 24 File: USPT Jul 20, 1999

US-PAT-NO: 5924286
DOCUMENT-IDENTIFIER: US 5924286 A

TITLE: Hydraulic supercharger system

DATE-ISSUED: July 20, 1999

INVENTOR-INFORMATION:

NAME	CITY	STATE	CODE	COUNTRY
Kapich; Davorin D.	Carlsbad	CA	92009	

US-CL-CURRENT: 60/608; 123/565

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

☐ 11. Document ID: US 5730784 A

L20: Entry 11 of 24 File: USPT Mar 24, 1998

US-PAT-NO: 5730784
DOCUMENT-IDENTIFIER: US 5730784 A

TITLE: Process for the removal of hydrogen sulfide from a gas stream

DATE-ISSUED: March 24, 1998

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Smith; James W.	Toronto			CA
Ellenor; David Todd R.	Pickering			CA
Harbinson; John N.	Scarborough			CA

US-CL-CURRENT: 95/181; 210/750, 210/758, 210/787, 261/84, 423/224, 423/242.1, 95/261

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

☐ 12. Document ID: US 5593888 A

L20: Entry 12 of 24 File: USPT Jan 14, 1997

US-PAT-NO: 5593888
DOCUMENT-IDENTIFIER: US 5593888 A

TITLE: Method for accelerated bioremediation and method of using an apparatus therefor

DATE-ISSUED: January 14, 1997

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Glaze; Bradley S.	Lyons	OR		
Warner; Kenneth R.	Gladstone	OR		
Horn; Terry D.	White Salmon	WA		
Horn; Ronald D.	Vancouver	WA		

US-CL-CURRENT: 435/262.5; 241/1, 241/15, 241/195, 241/26, 241/277, 241/5, 241/83, 241/DIG.38, 366/131, 366/189, 366/325.1, 366/327.1, 366/331, 366/345, 435/262, 588/203

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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13. Document ID: US 5585005 A

L20: Entry 13 of 24 File: USPT Dec 17, 1996

US-PAT-NO: 5585005
DOCUMENT-IDENTIFIER: US 5585005 A

TITLE: Method for effecting gas-liquid contact

DATE-ISSUED: December 17, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Smith; James W.	Toronto			CA
Ellenor; David T. R.	Pickering			CA
Harbinson; John N.	Scarborough			CA

US-CL-CURRENT: 210/703; 423/220, 423/224, 423/576.2

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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14. Document ID: US 5552061 A

L20: Entry 14 of 24 File: USPT Sep 3, 1996

US-PAT-NO: 5552061
DOCUMENT-IDENTIFIER: US 5552061 A

TITLE: Method for effecting gas-liquid contact

DATE-ISSUED: September 3, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Smith; James W.	Toronto Ontario			CA
Ellenor; David T. R.	Pickering, Ontario			CA
Harbinson; John N.	Scarborough, Ontario			CA

US-CL-CURRENT: 210/750; 210/758, 210/787, 261/84, 423/224, 423/242.1

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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15. Document ID: US 5527475 A

L20: Entry 15 of 24 File: USPT Jun 18, 1996

US-PAT-NO: 5527475
DOCUMENT-IDENTIFIER: US 5527475 A

TITLE: Method for determining the parameters of a gas-liquid contact apparatus

DATE-ISSUED: June 18, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	IP CODE	COUNTRY
Smith; James W.	Toronto			CA
Ellenor; David T. R.	Pickering			CA
Harbinson; John N.	Scarborough			CA

US-CL-CURRENT: 210/787; 210/221.2, 210/703, 210/758, 261/84, 422/168, 423/226

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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16. Document ID: US 5520818 A

L20: Entry 16 of 24 File: USPT May 28, 1996

US-PAT-NO: 5520818
DOCUMENT-IDENTIFIER: US 5520818 A

TITLE: Method for effecting gas-liquid contact

DATE-ISSUED: May 28, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Smith; James W.	Toronto			CA
Ellenor; David T. R.	Pickering			CA
Harbinson; John N.	Scarborough			CA

US-CL-CURRENT: 210/703; 210/221.1, 210/221.2, 210/512.3, 210/704, 210/758, 210/787, 261/84, 422/168, 423/220, 423/576.4

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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17. Document ID: US 5500135 A

L20: Entry 17 of 24 File: USPT Mar 19, 1996

US-PAT-NO: 5500135
DOCUMENT-IDENTIFIER: US 5500135 A

TITLE: Method for effecting gas-liquid contact

DATE-ISSUED: March 19, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Smith; James W.	Toronto			CA
Ellenor; David T. R.	Pickering			CA
Harbinson; John N.	Scarborough			CA

US-CL-CURRENT: 210/787; 210/221.1, 210/221.2, 210/703, 210/704, 210/758, 261/84, 422/168, 423/220, 423/512.1, 423/576.4

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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18. Documen : US 5500130 A

L20: Entry 18 of 24 File: USPT Mar 19, 1996

US-PAT-NO: 5500130
DOCUMENT-IDENTIFIER: US 5500130 A

TITLE: Method for effecting gas-liquid contact

DATE-ISSUED: March 19, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Smith; James W.	Toronto			CA
Ellenor; David T. R.	Pickering			CA
Harbinson; John N.	Scarborough			CA

US-CL-CURRENT: 210/703; 210/221.1, 210/221.2, 210/512.3, 210/704, 210/758, 210/787, 261/84, 422/168, 423/220, 423/576.4

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

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19. Document ID: US 5096262 A

L20: Entry 19 of 24 File: USPT Mar 17, 1992

US-PAT-NO: 5096262
DOCUMENT-IDENTIFIER: US 5096262 A

TITLE: Device for enlarging a chimney

DATE-ISSUED: March 17, 1992

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Foullois; Bernhard	D-2323 Nehmten			DE

US-CL-CURRENT: 299/55; 15/104.069, 241/277, 29/81.05, 299/80.1

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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20. Document ID: US 4809909 A

L20: Entry 20 of 24 File: USPT Mar 7, 1989

US-PAT-NO: 4809909
DOCUMENT-IDENTIFIER: US 4809909 A

TITLE: Plural component application system

DATE-ISSUED: March 7, 1989

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Kukesh; Timothy S.	Indianapolis	IN		

US-CL-CURRENT: 239/1; 239/124, 239/135, 239/336, 239/61, 239/74, 239/DIG.8, 417/218,

427/196, 427/426

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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☐ 21. Document ID: US 4344479 A

L20: Entry 21 of 24 File: USPT Aug 17, 1982

US-PAT-NO: 4344479
DOCUMENT-IDENTIFIER: US 4344479 A

TITLE: Process and apparatus utilizing common structure for combustion, gas fixation, or waste heat recovery

DATE-ISSUED: August 17, 1982

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bailey; Frank W.	New York	NY		

US-CL-CURRENT: 165/109.1; 122/155.2, 122/20B, 122/44.2, 165/DIG.321

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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☐ 22. Document ID: US 4179888 A

L20: Entry 22 of 24 File: USPT Dec 25, 1979

US-PAT-NO: 4179888
DOCUMENT-IDENTIFIER: US 4179888 A

TITLE: Hydraulic fan drive system

DATE-ISSUED: December 25, 1979

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Goscenski, Jr.; Edward J.	Battle Creek	MI		

US-CL-CURRENT: 60/420; 123/41.12, 60/456, 60/468, 60/484, 91/419

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

☐ 23. Document ID: US 3926794 A

L20: Entry 23 of 24 File: USPT Dec 16, 1975

US-PAT-NO: 3926794
DOCUMENT-IDENTIFIER: US 3926794 A

TITLE: Warm sludge digestion with oxygen

DATE-ISSUED: December 16, 1975

INVENTOR-INFORMATION:

NAME	CITY	STATE	CODE	COUNTRY
Vahldieck; Nathan P.	Snyder	NY		

US-CL-CURRENT: 210/604; 210/613, 210/625, 210/627

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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24. Document ID: US 3591109 A

L20: Entry 24 of 24 File: USPT Jul 6, 1971

US-PAT-NO: 3591109
DOCUMENT-IDENTIFIER: US 3591109 A

TITLE: ROTARY WING AIRCRAFT

DATE-ISSUED: July 6, 1971

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
McLarty; Frank W.	Dallas	TX	75208	

US-CL-CURRENT: 244/17.23; 244/17.19

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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Term	Documents
DIVERT$4	0
DIVERT.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	29494
DIVERTABLE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	93
DIVERTABLY.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	4
DIVERTADLY.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1
DIVERTANT.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	2
DIVERTAR.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1
DIVERTCR.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1
DIVERTD.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1
DIVERTE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	5
DIVERTEC.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	6
(L19 AND (DIVERT$4 OR BYPASS$5 OR SKIP$5 OR BY-PASS$5 OR REDIRECT$4 OR RE-DIRECT$4)).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	24

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L20: Entry 22 of 24 File: USPT Dec 25, 1979

DOCUMENT-IDENTIFIER: US 4179888 A
TITLE: Hydraulic fan drive system

Abstract Text (1):
A vehicle engine accessory drive system is disclosed including a hydraulic fan motor and a power steering gear mechanism in series flow relationship. The vehicle power steering pump is the sole source of fluid for the system and has its flow control setting at a flow rate X, which is substantially greater than the flow rate Z required by the power steering gear. A temperature responsive bypass valve is connected in parallel across the fan motor and the bypass flow and motor outlet flow recombine, then flow to a steering gear flow control which communicates a flow rate Z to the steering gear mechanism and all fluid in excess of Z bypasses the steering gear, recombining with the output flow from the steering gear and returning to the pump inlet. This system provides a flow to the fan motor resulting in a fan speed-versus-engine speed similar to a "viscous curve". In addition, the system permits simultaneous operation of the fan motor and steering gear without the flow requirement of either one affecting the flow to the other, and with the pressure requirements being complementary, i.e., the pressure drop across the fan motor is at a minimum when the steering load is at a maximum.

Brief Summary Text (2):
The present invention relates to hydraulic systems for driving the radiator cooling fans of vehicle engines, and more particularly, to such systems for use in vehicles in which the engines are oriented transversely.

Brief Summary Text (3):
Although it will become apparent from the subsequent description that the present invention has many uses and application, it is especially advantageous when used to drive the radiator cooling fan of a vehicle engine, and will be described in connection therewith.

Brief Summary Text (4):
Originally, radiator cooling fans were driven directly, i.e., by some form of mechanical connection between the fan and the engine crankshaft. For example, the fan was frequently bolted to a flange on a shaft projecting forwardly from the engine water pump, such that the fan speed was either the same as the engine speed, or directly proportional thereto, depending upon the belt and pulley ratios between the crankshaft and the water pump. The proportionality between fan speed and engine speed is desirable at lower engine speeds (e.g., below 3000 rpm), but is undesirable at higher speeds where additional air flow through the radiator becomes unnecessary, wastes engine horsepower and creates excessive noise.

Brief Summary Text (5):
More recently, viscous fan drives have been developed which overcome the above-mentioned problems whereby direct fan drive systems have excessive fan speed at higher engine speeds. Viscous fan drives transmit torque by means of a viscous fluid contained within a shear space defined between an input member and an output member, such that rotation of the input member causes a viscous shear drag to be exerted on the output member, transmitting torque thereto. See U.S. Pat. No. 2,948,268, assigned to the assignee of the present invention. Viscous fan drives of the type shown in the cited patent have an inherent torque-limiting characteristic, such that the fan speed increases roughly proportional to the engine speed, up to a certain engine speed such as 2500 rpm, then the fan speed levels off and remains constant as engine speed and torque continue to rise. The resulting graph of fan speed versus engine speed has become known as a "viscous curve", and it is now generally a requirement of U.S. vehicle manufacturers that any drive system, whether of the viscous type or not, operate in accordance with the well-known "viscous curve".

Brief Summary Text (6
A further step in the development of viscous fan drive[illegible]as represented by U.S. Pat. No. 3,055,473, which discloses a viscous fan drive having the same "viscous curve" during its normal operation condition (engaged), but in addition, has the ability to become disengaged in response to ambient air temperature being below a predetermined level, thus providing a substantial saving of engine horsepower when normal operation of the fan is unnecessary for sufficient cooling of the engine.

Brief Summary Text (8):
Both of the conventional fan drive arrangements discussed above can be used only with a standard in-line engine, i.e., one having the crankshaft oriented axially. However, in recent years many auto makers, especially in Europe, have elected to use a transverse engine, providing front wheel drive, for reasons which are now well known in the art, and the trend toward transverse engines, especially in the four and six cylinder range, is extending to the U.S. as well. In European transverse engine automobiles, the cooling requirements have generally been met rather easily for various reasons, including the fact that the majority of the vehicles have been used in the generally colder regions, such as the Scandinavian countries. However, the nature of the U.S. automobile market is such that all transverse engine vehicles market in the U.S. will be required to have sufficient cooling capacity to operate satisfactorily under the conditions prevailing in the hot southern regions of the country.

Brief Summary Text (9):
The attempts by those working in the art to provide a satisfactory fan drive system for use with transverse mounted engines has included many different approaches. One approach, which is analogous to the conventional direct fan drive system, is the use of an arrangement of shafts and bevel gears to translate the transverse crankshaft rotation into axial fan shaft rotation. See U.S. Pat. No. 3,613,645.

Brief Summary Text (10):
Another approach has been the use of an electric motor to drive the fan which provides the possibility of some sophistication in the control of fan speed. However, as the fan drive horsepower requirement reaches even the low end of the range indicated previously (0.5 hp), the size and expense of the needed electric motor may become prohibitive.

Brief Summary Text (12):
Another major approach to the cooling of transverse engines is the use of hydraulic systems, including a hydraulic pump driven by the engine and a hydraulic motor connected to the fan. It will be appreciated by those skilled in the art of automotive engines and engine accessories that the addition of a complete hydraulic system creates problems relating to space requirements, and undesirably increases both the weight and cost of the vehicle. Accordingly, those attempting to design a satisfactory hydraulic fan drive system have tried to reduce the space, weight, and cost of such systems by utilizing at least one of the hydraulic components in at least two different vehicle hydraulic systems. For example, there have been frequent attempts to utilize the power steering pump to provide pressurized fluid to operate a hydraulic fan motor, as well as the power steering gear (see U.S. Pat. No. 2,777,287). In such systems, inter-action between the fan motor and the other hydraulic actuator (such as the power steering gear) have generally resulted in unsatisfactory performance by the fan motor, or the steering gear, or both.

Brief Summary Text (13):
One design approach to such systems has been to place the fan motor in series with the power steering gear, but upstream therefrom, such that the flow through the fan motor also passes through the steering gear. See U.S. Pat. No. 3,659,567 which will be described in greater detail subsequently. A major drawback of such prior art systems has been a constant flow rate through the fan motor over all engine speeds from idle to maximum, such that fan speed is constant regardless of engine speed. Typically, the result with such a system is that more cooling than is needed is provided at lower engine speeds, thereby wasting engine horsepower, or the cooling may be only marginal at higher engine speeds, or both. In addition, such systems require a relatively high fan motor pressure and pump horsepower at lower engine speeds when the pressure drop across the power steering gear is greatest, thus making it difficult to satisfy the pressure and flow requirement of both the fan and steering system simultaneously.

Brief Summary Text (15):
Accordingly, it is an object of the present invention to provide a hydraulic fan drive system in which the fan motor operates, as a function of engine speed, in accordance with the desired viscous curve.

Brief Summary Text (1[illegible]
It is another object of the present invention to provide a hydraulic fan drive system which receives pressurized fluid from the power steering pump and in which the hydraulic fan motor and the power steering gear are more compatible.

Brief Summary Text (17):
The above and other objects of the present invention are accomplished by the provision of an improved vehicle accessory drive system. The system comprises an engine driven pump including a pumping element operable to deliver fluid at a rate generally proportional to engine speed. The pump includes fluid inlet and outlet ports, the pump having a fluid delivery rate of Y at engine idle. The pump comprises the sole source of pressurized fluid for the system and includes first flow control valve means operable to limit the fluid delivery rate from the pump outlet port to a flow rate of X at higher engine speeds, X being substantially greater than Y. The system includes first and second subsystems connected in series flow relationship between the pump outlet port and the pump inlet port. Each of these subsystems include inlet means and outlet means. One of the subsystems includes a hydraulic fan motor and a bypass valve. The hydraulic fan motor has an inlet port communicating with the subsystem inlet means and an outlet port communicating with the subsystem outlet means. The fan motor has a fan speed at engine idle corresponding to a fluid flow rate of approximately Y and a fan peak speed corresponding to a fluid flow rate of approximately X. The bypass valve means is connected in parellel with the fan motor, operable to bypass the fan motor and being responsive to the need for fan operation. The bypass valve means is capable of bypassing at least a major portion of X at a first relatively lower temperature condition and is capable of substantially preventing bypass flow at a second relatively higher temperature condition. The other of the subsystems includes a second flow control valve means and a steering gear mechanism. The second flow control valve means has its inlet in fluid communication with the subsystem inlet means and has primary and secondary fluid outlets. The second flow control valve means is operable to communicate a fluid flow rate of approximately Z from its inlet to the primary fluid outlet over substantially the entire range of operating engine speeds and is operable to communicate substantially all fluid flow in excess of Z from its inlet to the secondary fluid outlet, Z being substantially less than X. The secondary fluid outlet is in fluid communication with the subsystem outlet means. The steering gear mechanism has its inlet port connected to the primary fluid outlet and its outlet port connected to the subsystem outlet means.

Drawing Description Text (5):
FIG. 4 is a view, partly in elevation, and partly in cross section, of a motor-valve apparatus for use in the system of the present invention.

Detailed Description Text (2):
Referring now to the drawings, which are not intended to limit the invention, FIG. 1 is a somewhat schematic top plan view of the engine compartment of a vehicle utilizing the present invention. Transversely disposed within the compartment is a vehicle engine E including means (not shown) for transmitting torque to a pair of ground-engaging front wheels W. Disposed adjacent the right-hand end of the engine E and driven thereby is a water pump WP including a pair of pulleys, one of which drives a V-belt B1 which drives the alternator A, and the other of which drives a V-belt B2 which drives a power steering pump P. As is well known in the art, the power steering pump is driven at a speed having a certain, fixed relationship to engine speed, depending upon the ratio of the pulleys which are interconnected by the belt B2.

Detailed Description Text (3):
Disposed adjacent the forward portion of the vehicle engine compartment is a radiator R. A hose H1 communicates relatively hot water from the engine E to the top tank of the radiator R, while a second hose H2 communicates relatively cooler water from the radiator bottom tank to the engine water pump WP.

Detailed Description Text (4):
Situated in its normal location, just ahead of the fire wall FW is an open-center, hydraulic booster-type steering gear mechanism SG of the type commonly used, which is responsive to the rotation of a steering wheel SW to transmit a steering force to a drag link D.

Detailed Description Text (5):
The power steering pump P generates a flow of pressurized fluid which is communicated by means of a conduit C1 to a motor-valve apparatus MV, to which is operably attached a radiator cooling fan F. Some of the fluid leaving the motor-valve apparatus MV is communicated by conduit C2 to the open-center steering gear mechanism SG and from the steering gear SG back to the pump P by means of a

conduit C3. Alternatively, as will be described in greater detail subsequently, fluid may flow from the motor-valve apparatus MV by means of a conduit C4 which bypasses the steering gear SG and communicates with the conduit C3.

Detailed Description Text (6):
Referring now to FIG. 2, there is illustrated in greater detail the power steering pump P, which may be of the type well known in the art and therefore, will be described only briefly. The pump includes a housing 11, typically a casting, which defines a pumping chamber (not shown), with a rotatable pumping element (not shown) being disposed therein and driven by an input shaft 13. The pumping elements of automotive power steering pumps are typically of the sliding vane or roller vane type, but it is within the scope of the present invention for the pumping element of the power steering pump P to be of any type which is capable of pumping fluid at a rate generally proportional to the speed of rotation of the shaft 13 (and the engine speed).

Detailed Description Text (7):
The pump P includes a reservoir can 15 which surrounds a portion of the housing 11 and cooperates therewith to define a fluid reservoir. The reservoir can 15 is held fixed relative to the housing 11 by several threaded members (some of which are not shown), including a threaded orifice member 17, which will be described in greater detail subsequently.

Detailed Description Text (8):
The housing 11 defines a cylindrical bore 19, a portion of which defines a set of internal threads for threaded engagement with the orifice member 17. Pressurized fluid is communicated from the discharge port of the pumping element into the bore 19 by means of a passage 21, and excess fluid may be communicated from the bore 19 back to the inlet port of the pumping element by means of a passage 23.

Detailed Description Text (9):
Slidably disposed within the bore 19 is a bypass valve piston 25, which is biased to the right in FIG. 2 by a compression spring 27, and biased to the left by the pressure of fluid being discharged into the bore 19 through passage 21. The orifice member 17 communicates the pressurized discharge fluid from the passage 21, through a metering orifice 29 to a threaded discharge port 31 to which is connected the upstream end of the conduit C1 (from FIG. 1).

Detailed Description Text (10):
The orifice member 17 defines a radial passage 33 which communicates a pressure signal from the metering orifice 29, through a series of drilled signal passages 35, 37, and 39 to a signal chamber 40, adjacent the left end of the piston 25. As is well known in the art of power steering pumps, the bypass flow control arrangement described above is commonly used and provides an output flow from the discharge port 31 which is directly proportional to engine speed, and pump input speed, up to a predetermined flow rate, at which point the flow rate from the discharge port 31 levels off and remains constant as engine speed continues to rise.

Detailed Description Text (11):
The above-described flow control feature is illustrated graphically in FIG. 3, which is a hydraulic schematic of the fan drive system of the present invention. In order to provide a better understanding of the invention, various portions of the schematic of FIG. 3 have associated therewith a graph of flow versus speed (either engine or pump input). It should be noted that the graphs do not include numbers, indicating specific flow quantities or specific speeds, but are intended merely to indicate relative flow quantities for purposes of describing the invention schematically and conceptually. However, it should also be noted that the graphs cover what will be referred to hereinafter as the "range of operation engine speeds", i.e., speeds ranging from approximately engine idle up to an engine speed corresponding to a typical vehicle cruising speed, such as 55 mph.

Detailed Description Text (12):
Referring still to FIG. 3, it may be seen in graph No. 1 that the power steering pump P, which is the sole source of pressurized fluid for the system, delivers fluid through the conduit C1 to the motor-valve apparatus MV at a rate of Y at engine idle. The flow rate through the conduit C1 increases generally proportional to input speed until a flow rate of X occurs, and as engine speed increases further, all fluid in excess of X is recirculated internally within the pump P as was described previously. As may be seen in graph No. 1, the flow rate X is substantially greater than the flow rate Y.

Detailed Description Text (13):
Pressurized fluid entering the motor-valve apparatus MV flows through one of two

alternative flow path. When operation of the radiator cooling fan F is required, substantially all of the fluid entering the motor-valve apparatus MV flows through the fan motor, generally designated 41, as is illustrated by the solid line in graph No. 2. In this condition, the fan motor 41 is referred to as being "engaged", and practically no fluid passes through the temperature bypass valve, as is illustrated by the lack of a solid line in graph No. 3.

Detailed Description Text (14):
Although the flow into the fan motor 41, in the engaged condition, is shown in graph No. 2 as substantially identical to the pump output shown in graph No. 1, it should be understood that such a relationship is not an essential feature of the present invention. Thus, the flow through the motor 41 could be somewhat less than the flow rate of X, although normally it would be desirable to utilize the full pump output to drive the motor 41, thereby minimizing the pressure drop needed to achieve a desired fan drive horsepower, as will be explained in greater detail subsequently.

Detailed Description Text (15):
When very little cooling is required, and it is sufficient for the fan motor 41 to turn the fan F at a relatively low speed, the fan motor 41 is referred to as being "disengaged", as is illustrated by the dashed flow curves in graphs No. 2 and No. 3. From graph No. 2 it may be seen that a certain quantity of fluid will be permitted to drive the fan motor 41, while the remainder of the fluid flows through the temperature bypass valve, bypassing the motor 41. It should be understood that the relationship of flow through the motor 41 (in the disengaged condition) and the input speed is not limited to that shown in graph No. 2, which is by way of example only, but may vary somewhat depending upon the set points of the system.

Detailed Description Text (16):
The temperature bypass valve, which will be described in greater detail subsequently, may be of the type generally well known in the art, responsive to ambient air temperature within the engine compartment or to water temperature within the radiator or engine block. However, it should be understood that the present invention is not limited to any particular arrangement for making the bypass valve temperature responsive, and it is within the scope of the present invention for the bypass valve to be actuated mechanically, electrically, or in any other manner, in response to air temperature, water temperature, or any other similar indication of the need for cooling of the radiator or operation of the cooling fan F. Merely by way of example, the bypass valve could be operated by a head pressure switch in response to variations in head pressure within the air conditioning compressor.

Detailed Description Text (17):
The outlet flow from the fan motor 41 and the bypass flow, if any, recombine within the motor-valve apparatus MV and flow into a steering gear flow control, such that regardless of the need for cooling, the input to the steering gear flow control may be represented by a flow curve substantially as in graph No. 1.

Detailed Description Text (18):
The purpose of the steering gear flow control is to provide to the steering gear mechanism SG the required quantity of fluid. As is well known to those skilled in the art, the conventional automotive steering gear mechanism is of the open-center type such that the steering gear is designed to have a generally constant flow rate therethrough, with the fluid pressure being dependent upon the steering load. One of the reasons for the conventional steering gears being open-center is the desire to use a fixed displacement power steering pump, the least expensive type of pump. However, as will be understood by those skilled in the hydraulics art, the inclusion of the steering gear flow control in the present invention effectively makes the overall system open-center, even if a closed-center steering gear were substituted for the conventional open-center steering gear. Therefore, it is within the scope of the present invention to use a steering gear mechanism SG which is not open-center, in which case, the steering gear flow control directs fluid to the steering gear SG only in response to a "demand" for fluid. Accordingly, the system includes a steering gear flow control capable of communicating a fluid flow rate of approximately Z (graph No. 4) to the steering gear mechanism SG over the entire range of operating engine speeds, the flow rate Z being substantially less than the flow rate X.

Detailed Description Text (19):
Although graph No. 4 illustrates the flow rate Z as constant, it should be appreciated that the flow rate through the steering gear SG is an inherent feature of the steering gear, and therefore, the curve of flow rate Z in graph No. 4 could vary from that shown. For example, the line could slope somewhat in either direction and/or could include a slight rise or drop at one end or the other. Furthermore, in the subject embodiment, the system components are sized such that the flow rate Y

from the pump P at engine idle is substantially identical to the flow rate Z through the steering gear SG, although, within the scope of the present invention, the flow rate Y may be greater than the flow rate Z, or less than the flow rate Z which occurs at higher engine speeds if Z is not perfectly constant.

Detailed Description Text (20):
At the same time, the steering gear flow control is operable to communicate substantially all of the inlet fluid flow in excess of Z (graph No. 5) through the conduit C4 to bypass the steering gear and recombine with the fluid leaving the steering gear by means of the conduit C3. Downstream of the junction of the conduits C3 and C4, it may be seen (graph No. 6), that the flow returning to the inlet of the power steering pump P is substantially identical to the flow being discharged from the pump P. It may also be seen that the present invention makes it possible to drive a hydraulic fan motor and operate a hydraulic steering gear mechanism in series, using a conventional power steering pump (with a modified flow control setting), with each of the fan motor and the steering gear receiving the quantity of fluid appropriate for its operation, independent of the other. This aspect of the invention will be described in greater detail subsequently.

Detailed Description Text (21):
Referring now to FIGS. 4 through 6, a preferred embodiment of the motor-valve apparatus MV will be described in detail. As may best be seen in FIG. 4, the motor-valve apparatus MV includes the fan motor 41 and a valve portion 43, held together by a plurality of bolts 45. Although, in the subject embodiment, the fan motor 41 and valve portion 43 are illustrated as an assembly, it will be apparent to those skilled in the art that the motor 41 and valve portion 43 could be separate from each other, and could be combined with various other system components. For example, the valve portion 43 could be combined with the power steering pump P or the steering gear mechanism SG. However, in the subject embodiment, the motor 41 and valve portion 43 have been combined for reasons which will become apparent.

Detailed Description Text (22):
The fan motor 41 comprises a front cover member 47 and, disposed between the cover member 47 and the valve portion 43, a gerotor gear set 49. The gerotor gear set 49 includes an externally toothed inner rotor 51, eccentrically disposed within an internally toothed outer rotor 53, the outer rotor 53 being rotatably disposed within a spacer ring 55. As is well known in the art of gerotor gear sets, the inner rotor 51 has one less tooth than the outer rotor 53, such that the toothed engagement of the rotors 51 and 53 defines a plurality of fluid volume chambers 57. It should be understood that the use of a gerotor gear set in the motor 41 is not an essential feature of the present invention. However, it is preferred that the motor comprise a positive displacement device, operable to translate a flow of pressurized fluid into a rotary output and that the device define expanding and contracting fluid volume chambers. Examples of other types of devices which may be used herein are internal and external gear, sliding vane, radial piston or ball, and axial piston or ball.

Detailed Description Text (23):
The valve portion 43 includes a housing 59 defining an inlet kidney port 61 and an outlet kidney port 63 (see also FIG. 6). As will be further described subsequently, pressurized fluid from the inlet kidney port 61 is communicated to the volume chambers which are expanding, thereby turning the inner rotor 51, while fluid in the volume chambers which are contracting is discharged into the outlet kidney port 63. The inner rotor 51 is keyed to an output shaft 65 which drivingly engages a backup plate 67.

Detailed Description Text (24):
The radiator cooling fan F, the specific design of which forms no part of the present invention, is shown herein as a combination plastic and metal fan assembly. Attached to the backup plate 67 by a plurality of bolts 69 is a metal spider 71, including a plurality of openings 73 through which incoming air is permitted to flow. The metal spider includes an annular outer portion 75 embedded within, and surrounded by a hub portion 77 of a plastic fan, the plastic fan including a plurality of fan blades 79 extending radially from the hub 77.

Detailed Description Text (25):
Referring now to FIG. 5, in conjunction with FIG. 4, it may be seen that the front cover member 47 includes a plurality of cooling fins 81, the purpose of which is to achieve cooling of the hydraulic fluid as it flows through the gerotor gear set 49. This cooling of the fluid is aided by the movement of air axially through the openings 73 in the metal spider 71 and into the fins 81. The fins 81, which are not an essential feature of the invention, could take various other forms and orientations. For example, the fins 81 could be arranged to extend radially.

Detailed Description Text (26):
Referring now to FIG. 6, which is a transverse cross section through the valve portion 43, but on a larger scale than FIG. 4, the construction and operation of a preferred embodiment of the valve portion 43 will be described in detail. The housing 59 defines an inlet passage 83 having, at its right end in FIG. 6, a threaded inlet port 85. Disposed within the inlet passage 83 is a deformable fitting member 87 which sealingly engages a fitting (not shown) at the end of the conduit C1 when the fitting is threaded into the inlet port 85. The inlet passage 83 communicates with a fluid pressure port 89, which opens into the inlet kidney port 61 to communicate pressurized inlet fluid from the pump P to the expanding volume chambers as described previously.

Detailed Description Text (27):
The housing 59 also defines an outlet passage 91, and a bypass passage 93 providing fluid communication between the inlet passage 83 and the outlet passage 91. The bypass passage 93, adjacent its intersection with the outlet passage 91, communicates with a fluid return port 95, which receives from the outlet kidney port 63 the fluid being exhausted from the contracting volume chambers as was described previously.

Detailed Description Text (29):
In the subject embodiment, the bypass passage 93 intersects the outlet passage 91 and defines a set of internal threads which receive a threaded sealing plug 105. Disposed to the right of the plug 105 in FIG. 6 is a secondary passage 107 which communicates with the outlet passage 91 and defines a secondary outlet port 109. Disposed within the passage 107 is a deformable fitting 111 which sealingly engages a fitting (not shown) attached to the upstream end of the conduit C4, when the fitting is threaded into the secondary outlet port 109.

Detailed Description Text (30):
Disposed at the left end of the inlet passage 83 is a temperature responsive bypass valve assembly, generally designated 113. The valve assembly 113 includes a bypass piston 115, slidably disposed within the inlet passage 83 between first and second positions. In the first position (as shown in FIG. 6) the piston 115 substantially prevents fluid communication from the inlet passage 83 to the bypass passage 93. The bypass piston 115, in the second position, is disposed to the left of the position shown in FIG. 6, and fluid flow is permitted from the inlet passage 83 to the bypass passage 93 at a flow rate which is at least a major portion of the flow rate X, as described previously in connection with graph No. 3 in FIG. 3.

Detailed Description Text (31):
The position of the bypass piston 115 and thus, the speed of operation of the fan motor 41, is determined by a temperature sensing and positioning assembly 117, which includes a power element, generally designated 119. The power element 119 includes a container 121 which is in threaded engagement with the housing 59 at threads 123. Projecting from the power element 119 is a pushrod 125 engaging the left end of the bypass piston 115, which is biased into engagement with the pushrod 125 by a biasing spring 127, seated against the fitting 87. The bypass piston 115 defines a pilot passage 116 communicating pressure from the front side (right side in FIG. 6) of the piston 115 to the back side thereof to balance the fluid pressures acting on the piston. Thus, the net axial load on the pushrod 125 of the power element 119 is merely the compression force of the spring 127.

Detailed Description Text (32):
The container 121 is filled with a wax material having a high coefficient of expansion at its liquid-solid phase change temperature, as is well known in the fan drive art. When the temperature of the power element 119 reaches a predetermined level, the wax in the container 121 liquifies and expands substantially, moving the pushrod 125 to the right (in FIG. 6), thereby moving the bypass piston 115 toward the position shown in FIG. 6 in which substantially all of the fluid entering the inlet port 85 flows through the pressure port 89 to operate the fan motor 41.

Detailed Description Text (33):
In the subject embodiment, the particular temperature condition to which the temperature sensing and positioning assembly 117 responds is the temperature of the water flowing from the engine block to the top tank of radiator R, frequently referred to as "top-tank". Therefore, the bypass piston 115 is in its first position, preventing bypass flow, at a relatively higher temperature, and is in its second position, permitting bypass flow, at a relatively lower temperature. By way of example only, and in reference to top-tank temperature, a "relatively higher temperature" would be about 240 degrees F. (115 degrees C.) and a "relatively lower temperature" would be about 220 degrees F. (104 degrees C.).

Detailed Description Text (34):
Referring to FIG. 1, it may be seen that a small hose H3 branches off of the main water hose H1 adjacent the engine E and communicates a certain volume of hot water to the motor-valve apparatus MV to accomplish the necessary temperature sensing. Another hose H4 communicates this same hot water to the radiator where the water recombines with the rest of the hot water communicated by the hose H1 from the engine to the radiator. Referring again to FIG. 6, in conjunction with FIGS. 4 and 5, it may be seen that the wax filled container 121 is surrounded by a molded plastic enclosure 129 which is attached to the housing 59 by a pair of machine screws 131. The enclosure 129 includes an inlet portion 133 (FIGS. 4 and 5), adapted to have the hose H3 clamped thereabout, permitting the hot temperature-sensing water to fill the enclosure 129 and control the power element 119 as described previously. Hot water is permitted to flow out of the enclosure 129 through an outlet portion 135, adapted to have the hose H4 clamped thereabout.

Detailed Description Text (35):
Referring again primarily to FIG. 6, in conjunction with FIG. 3, it may be seen that substantially all of the fluid entering the inlet port 85, whether it flows through fan motor 41 or through the bypass passage 93, enters the outlet passage 91. Disposed within the outlet passage 91 is the steering gear flow control (shown schematically in FIG. 3), which includes the orifice member 99 and a second bypass piston 137. The bypass piston 137 is slidably disposed within the outlet passage 91, is biased to the right in FIG. 6 by the pressure of fluid entering the outlet passage 91, and to the left by the combined force of a biasing spring 139 and the fluid pressure within a pressure chamber 140.

Detailed Description Text (36):
As was explained in connection with the schematic of FIG. 3, it is the function of the steering gear flow control to communicate to the steering gear SG the desired quantity of fluid, regardless of engine speed or fluid pressure within the system, and to bypass all fluid in excess of the desired quantity. To accomplish this flow control function, the orifice member 99 defines a metering orifice 141 which communicates with a radial passage 143 and an annular groove 145. The passage 143 and groove 145 communicate a pressure signal from the metering orifice 141 to the pressure chamber 140 through a passage 147 defined by the housing 59. It is believed that the principle of operation of a flow control arrangement of the type disclosed herein is sufficiently well known to those skilled in the art that only a brief explanation is required. When the quantity of fluid entering the outlet passage 91 is approximately that required for operation of the steering gear, the pressure signals acting on the bypass piston 137 will be such that the piston 137 will move to the left from the position shown in FIG. 6 to substantially prevent communication from the outlet passage 91 to the secondary outlet port 109.

Detailed Description Text (37):
As the quantity of fluid entering the outlet passage 91 increases beyond that required to operate the steering gear, the pressure drop across the metering orifice 141 begins to increase, biasing the bypass piston 137 toward the right in FIG. 6, beginning to permit fluid communication from the outlet passage 91 to the secondary outlet port 109. As the pump speed continues to increase, and the flow into the outlet passage 91 reaches the flow rate X, the bypass piston 137 moves to approximately the position shown in FIG. 6, such that a major portion of the fluid entering the outlet passage 91 flows to the secondary outlet port 109, bypassing the steering gear (flow rate X-Z in graph No. 5).

Detailed Description Text (39):
In FIG. 7A, the bypass valve assembly 113 includes a bypass piston 115' which is biased to the left by the spring 127, and biased to the right by a spring 228, seated against flange 226 formed on the pushrod 125'. The spring 228 is received within a central open portion defined by the bypass piston 115', the open portion being in fluid communication with the bypass passage 93 by means of a radial passage 216 and an annular channel 218. Thus, the bypass piston 115' is not subjected to balanced fluid pressures as in the embodiment of FIG. 6, but instead, is subjected to the pressure drop across the fan motor 41 (i.e., the pressure drop from the pressure port 89 to the return port 95).

Detailed Description Text (40):
In FIG. 7B there is shown an arrangement in which the bypass piston 115" is biased to the left, into engagement with the pushrod 125" by a spring 127. The bypass piston 115" defines a pilot passage 116" such that, under normal operating conditions, the piston 115" is subjected to balanced fluid pressures. The piston 115" also defines a second pilot passage 320 which opens into an enlarged bore having its right end sealed by a ball 322 pressed into the bore. Seated against the

right end of the pilot passage 320 is a ball valve 324, biased to the closed position by a spring 326, seated against the ball 322. In the event that the fluid pressure within the inlet passage 83 rises to an undesirably high level (for example, if the fan motor 41 seizes up), the excessive pressure is communicated through the pilot passage 116" and through the pilot passage 320 to unseat the ball valve 324. The relieved fluid then flows out through the radial passage 316, through the annular bore 318 into the bypass passage 93, thus relieving the pressure acting on the left face of the bypass piston 115", permitting it to move to approximately the position shown in FIG. 7B. Therefore, sufficient inlet fluid will bypass the fan motor 41 and be available downstream to operate the power steering gear SG.

Detailed Description Text (41):
In FIG. 8 there is shown an alternative embodiment of not only the bypass piston, but also of the manner of controlling the position of the bypass piston. The housing 59"' includes a generally cylindrical portion 430, and defines the inlet passage 83"'. The bypass piston 115'" may have any of the several configurations described previously, but is illustrated in FIG. 8 as including only a pilot passage 116''', such that the fluid pressures acting on the bypass piston 115''' are balanced. Surrounding the housing portion 430 is an electromagnetic coil 432 which is operable, when energized, to exert a biasing force on the bypass piston 115''' to move it from the position shown in FIG. 8 toward the right (i.e., to block bypass flow), in opposition to the force of the spring 127. Energization of the electro-magnetic coil 432 may typically be accomplished from a power source such as the vehicle battery B and, in FIG. 8, is illustrated as being controlled by a parallel combination of switches. The switch arrangement includes a radiator temperature switch 434 and a compressor head pressure switch 436. If either of the switches 434 or 436 is subjected to a condition indicative of the need for operation of the fan F, the particular switch closes, permitting the coil 432 to be energized, and causing substantially all fluid entering the inlet passage 83''' to flow through the fan motor 41. In general, although the switch arrangement shown in FIG. 8 results in "on-off" operation of the coil 432, it would be obvious to modify the switch arrangement to provide some sort of proportional control of the coil 432, i.e., partial energization proportional to the need for fan operation.

Detailed Description Text (42):
In the background portion of the present specification there was a brief discussion of the hydraulic fan drive system illustrated in U.S. Pat. No. 3,659,567, which will be referred to hereinafter as the "prior art" hydraulic fan drive system. In the prior art system, the hydraulic fan motor and the power steering mechanism are in a series circuit, supplied with pressurized fluid by a "constant flow" pump, i.e., a power steering pump which reaches its maximum output flow rate at about engine idle, such that the output flow rate of the pump is substantially constant over the range of engine operating speeds. The prior art system further includes a temperature responsive bypass valve, operable to bypass the fan motor when operation of the fan in unnecessary. Therefore, when the prior art system is in the "engaged" condition, the flow through the fan motor is substantially constant over the range of operating engine speeds, and is substantially the same as the flow rate through the steering gear.

Detailed Description Text (43):
The above-described relationship is illustrated in FIG. 9, which is a graph of fan speed (rpm) versus engine speed (rpm). It may be seen that both the prior art system and a typical electric fan drive provide a substantially constant fan speed over the range of operating engine speeds, whereas the curve representing the fan drive system of the present invention conforms generally to the typical viscous curve, as is normally required by U.S. vehicle manufacturers. It should also be understood that the system of the present invention can be modified to provide practically any desired curve of fan speed versus engine speed. For example, the sloped portion of the curve may be shifted to the right by decreasing the displacement of the fan motor 41, or shifted to the left by increasing the displacement of the fan motor. The slope or angle of the slope portion can be reduced (made flatter) by reducing the displacement of the power steering pump P, or made steeper by increasing the displacement of the pump. Finally, the level portion of the curve can be shifted upward by increasing the maximum flow rate permitted by the bypass flow control valve in the power steering pump P, or can be shifted downward by reducing the maximum flow rate permitted.

Detailed Description Text (44):
In order to further illustrate the improved performance of the present invention over the prior art system, an example will be presented. The example will make reference to FIG. 10, which is a graph of Incremental Horsepower versus Engine Speed, and for each of the three alternative systems, provides a comparison of fan horsepower and input horsepower. As used herein, the term "incremental horsepower"

means, in reference to fan horsepower, the amount of horsepower actually consumed by the fan motor, and in reference to the input horsepower, the amount of horsepower required by the pump over and above that required to drive the steering gear.

Detailed Description Text (45):
In order to provide a meaningful comparison of the prior art system and the present invention, it is necessary to have the same steering gear mechanism in each of the hydraulic systems, and for purposes of FIG. 10 and the example, it has been assumed that the open-center steering gear mechanism receives a substantially constant flow of 2.0 gpm. A related assumption is that in both of the hydraulic systems, the power steering pumps are the same internally, i.e., they have the same pumping element and displacement. This assumption follows logically if both power steering gears are to receive 2.0 gpm at engine idle. The comparison is also based upon the assumption that, at peak fan speeds, each of the three fan motors consumes about 0.75 hp, as is shown in FIG. 10. As is well known to those skilled in the art, the horsepower consumed by the fan motor is determined by the torque required to turn the fan at the given speed, and in turn, the fan torque is related to such factors as the size and design of the fan.

Detailed Description Text (46):
As was stated in the background of the present specification, the size and cost of an electric motor capable of providing the necessary fan horsepower is probably prohibitive. However, for purposes of a complete comparison, FIG. 10 includes a graph of the approximate input horsepower required for an electric fan motor to provide 0.75 hp to drive the fan. Based upon typical efficiency values of fifty percent for both the electric motor and the vehicle alternator, it is seen in FIG. 10 that about 3.0 hp is required as the input to the alternator, thus making the electric fan system about twentyfive percent efficient.

Detailed Description Text (48):
eff.--overall fan motor efficiency;

Detailed Description Text (51):
hp--input horsepower to fan motor;

Detailed Description Text (52):
Q--flow rate (gpm) discharged by pumping element;

Detailed Description Text (53):
q--flow rate (gpm) through fan motor;

Detailed Description Text (54):
dP--pressure drop (psi) across fan motor.

Detailed Description Text (56):
As was indicated in the graphs of FIG. 3, the flow rate X is substantially greater than the flow rate Y, and in the subject embodiment, with the flow rate Y being 2.0 gpm, the flow rate X is taken to be 6.0 gpm. Below is a table comparing the prior art system and the present invention, at an engine speed of about 1800 rpm with the first column indicating the system characteristic ("Quantity"), and the second column indicating its "Source", either than the Quantity was assumed ("given") or that it was calculated.

Detailed Description Text (58):
Turning now to the condition at engine idle, it should be remembered that the prior art system still operates at the same fan speed, but with pump input speed reduced to about one third of that in the previous table. However, because of the "viscous" characteristics of the invention, fan speed drops to about one-third of that previously considered. As is well known in the art, fan torque varies as the square of the fan speed, and pressure drop across the fan motor is proportional to fan torque. Therefore, as fan speed drops to one-third pressure drop across the fan motor drops to one-ninth (of 285 psi) or 32 psi.

Detailed Description Text (60):
Therefore, while the prior art system consumes three times as much horsepower as the invention during normal operation, it consumes twenty-seven times as much horsepower at engine idle, while operating. It should be understood that because the prior art system provides a greater amount of horsepower to the fan at idle (FIG. 10), the prior art system is engaged a smaller percent of the time than the system of the invention. As a result, total horsepower consumed by the prior art fan motor over a period of time at idle is substantially greater than the invention, but not by a factor of 27. It should also be noted from FIG. 10 that for each of the systems (prior art and invention), the difference between input hp and fan hp represents

heat which must be dissipated from the system. For example, at an engine speed of 3,000 rpm, the prior art system must dissipate over 4 hp while the invention must dissipate only about 1 hp.

Detailed Description Text (61):
Moreover, as is well known in the art, the steering load (i.e., pressure drop across the power steering gear) is greatest at engine idle and decreases rapidly as vehicle speed increases. Because the fan motor and the steering gear are in hydraulic series, the pump must be able to supply a pressure which is the sum of the pressure drops across the fan motor and steering gear. Assuming a steering load of about 1000 psi at engine idle (or low speed, such as during parking), the system of the present invention would require a pump output pressure of about 1032 psi (1000+32), whereas the prior art system would require about 1857 psi (1000+857), well above a typical power steering pump relief setting of about 1200 psi. In the system provided by the invention, the pressure requirements are complementary, i.e., fan motor pressure is lowest when steering pressure is highest (engine idle), and steering pressure is lowest when fan motor pressure is highest (cruising speed).

Detailed Description Text (62):
Referring now to FIG. 11, there is illustrated an alternative embodiment of the system of FIG. 3, with like elements bearing like references. The primary difference between the FIG. 11 embodiment and that of FIG. 3 is the flow sequence, i.e., in FIG. 3, the output from the power steering pump P flows through the fan motor 41, then through the steering gear SG. In FIG. 11, the output flow from the power steering pump P enters the motor-valve apparatus MV' and flows to the steering gear flow control, which permits fluid to flow through the steering gear SG at a flow rate of Z. All fluid in excess of the flow rate Z is directed downstream by the steering gear flow control in the same manner as indicated by graph No. 5 in FIG. 3.

Detailed Description Text (63):
The excess fluid from the steering gear flow control and the flow through the steering gear SG recombine, then flow either through the fan motor 41 or through the temperature bypass valve in the same manner as indicated by graphs No. 2 and No. 3, respectively, in FIG. 3. The flows through the fan motor 41 and the temperature bypass valve recombine and return to the pump P.

Detailed Description Text (64):
Accordingly, it may be seen that in the alternative embodiment of FIG. 11, each of the individual components operates in substantially the same manner as in the preferred embodiment, and in certain circumstances, the embodiment of FIG. 11 may be preferred. However, the FIG. 3 embodiment is normally preferred because the commercially available power steering gear mechanisms may not be able to withstand the higher fluid pressure to which it would be subjected if it were the upstream component as in FIG. 11. It should be apparent that the physical arrangement of the motor-valve apparatus MV', for use in the FIG. 11 system, would be different than the apparatus MV for use in the FIG. 3 system. However, it would be obvious to one skilled in the art, based upon FIGS. 4,5, and 6 and the associated specification, how to construct the apparatus MV' to make the FIG. 11 system operate satisfactorily.

CLAIMS:

1. A vehicle engine accessory drive system comprising:

(a) an engine driven pump including a pumping element operable to deliver fluid at a rate generally proportional to engine speed, and fluid inlet and outlet ports, said pump having a fluid delivery rate of Y at engine idle, said pump comprising the sole source of pressurized fluid for said system and including first flow control valve means operable to limit the fluid delivery rate of said pump to X at higher engine speeds, X being substantially greater than Y;

(b) a hydraulic fan motor having fluid inlet and outlet ports, said fluid inlet port being connected to said pump outlet port, said fan motor having a fan speed at engine idle corresponding to a fluid flow rate of approximately Y, and a fan peak speed corresponding to a fluid flow rate of approximately X;

(c) bypass valve means connected in parallel with said fan motor, operable to bypass said fan motor and being responsive to the need for cooling, said bypass valve means being capable of bypassing at least a major portion of X at a first relatively lower temperature and capable of substantially preventing bypass flow at a second relatively higher temperature;

(d) second flow control valve means having its inlet in fluid communication with said outlet port of said fan motor and with said bypass flow, said second flow control valve means having primary and secondary fluid outlets and being operable to communicate a fluid flow rate of approximately Z from said fluid inlet to said primary outlet over substantially the entire range of operating engine speeds and to communicate substantially all fluid flow in excess of Z from said inlet to said secondary outlet, Z being substantially less than X;

(e) an open-center steering gear mechanism having inlet and outlet ports, said inlet port being in fluid communication with said primary outlet of said second flow control valve means;

(f) said outlet port of said steering gear mechanism and said secondary outlet of said second flow control valve means being in fluid communication with said fluid inlet port of said pump.

2. A system as defined in claim 1 wherein fluid flow rates Y and Z are approximately equal.

3. A system as defined in claim 1 wherein said flow rate Z is in the range of about 2 gpm (7.5 lpm) and said flow rate X is in the range of about 6 gpm (23.5 lpm).

4. A vehicle engine accessory drive system comprising:

(a) an engine driven pump including a pumping element operable to deliver fluid at a rate generally proportional to engine speed, and fluid inlet and outlet ports, said pump having a fluid delivery rate of Y at engine idle, said pump comprising the sole source of pressurized fluid for said system and including first flow control valve means operable to limit the fluid delivery rate from said pump outlet port to a flow rate of X at higher engine speeds, X being substantially greater than Y;

(b) first and second subsystems connected in series flow relationship between said pump outlet port and said pump inlet port, each of said subsystems including inlet means and outlet means;

(c) one of said subsystems including:

(i) a hydraulic fan motor having an inlet port communicating with the subsystem inlet means and an outlet port communicating with the subsystem outlet means, said fan motor having a fan speed at engine idle corresponding to a fluid flow rate of approximately Y, and a fan peak speed corresponding to a fluid flow rate of approximately X;

(ii) bypass valve means connected in parallel with said fan motor, operable to bypass said fan motor and being responsive to the need for fan operation, said bypass valve means being capable of bypassing at least a major portion of X at a first relatively lower temperature condition and capable of substantially preventing bypass flow at a second relatively higher temperature condition;

(d) the other of said subsystems including:

(i) second flow control valve means having its inlet in fluid communication with the subsystem inlet means, said second flow control valve means having primary and secondary fluid outlets, being operable to communicate a fluid flow rate of approximately Z from its inlet to said primary fluid outlet over substantially the entire range of operating engine speeds and to communicate substantially all fluid flow in excess of Z from its inlet to said secondary fluid outlet, Z being substantially less than X;

(ii) said secondary fluid outlet being in fluid communication with the subsystem outlet means;

(iii) a steering gear mechanism having its inlet port connected to said primary fluid outlet and its outlet port connected to the subsystem outlet means.

5. A vehicle engine accessory drive system comprising:

(a) an engine driven pump defining fluid inlet and outlet ports and including a pumping element operable to discharge fluid at a rate generally proportional to engine speed, said pump having a fluid flow rate of Y at engine idle, and including first flow control valve means operable to limit the fluid flow rate from said pump outlet port to a flow rate of X at higher engine speeds, X being substantially greater than Y; said pump comprising the sole source of pressurized fluid for said

system;

(b) second flow control valve means having its inlet in fluid communication with said pump outlet port and having primary and secondary fluid outlets, said second flow control valve means being operable to communicate a fluid flow rate of approximately Z from said fluid inlet to said primary outlet over substantially the entire range of operating engine speeds and to communicate substantially all fluid flow in excess of Z from said inlet to said secondary outlet, Z being substantially less than X;

(c) a steering gear mechanism having an inlet port in fluid communication with said primary fluid outlet, and an outlet port;

(d) a hydraulic fan motor having fluid inlet and outlet ports, said fluid inlet port being in fluid communication with said outlet port of said steering gear mechanism and with said secondary outlet of said steering gear flow control, said fan motor outlet port being in fluid communication with said pump inlet port, said fan motor having a fan speed at engine idle corresponding to a fluid flow rate of approximately Y, and a fan peak speed corresponding to a fluid flow rate of approximately X;

(e) bypass valve means connected in parallel with said fan motor, operable to bypass said fan motor and being responsive to the need for cooling, said bypass valve means being capable of bypassing at least a major portion of X at a first relatively lower temperature and capable of substantially preventing bypass flow at a second relatively higher temperature.

6. A system as defined in claim 4 or 5 wherein said fluid flow rates Y and Z are approximately equal.

7. A system as defined in claim 4 or 5 wherein said flow rate Z is in the range of about 2 gpm (7.5 lpm) and said flow rate X is in the range of about 6 gpm (23.5 lpm).

8. A system as defined in claim 1 or 4 or 5 wherein said hydraulic fan motor comprises a positive displacement rotary device defining expanding and contracting fluid volume chambers.

10. Motor-valve apparatus for use in a hydraulic fan drive system including a pump having fluid inlet and outlet ports and a pumping element operable to deliver fluid at a rate proportional to engine speed, the pump having a fluid delivery rate of Y at engine idle, the pump comprising the sole source of pressurized fluid for the system and including flow control valve means operable to limit the fluid delivery rate of the pump to X at higher engine speeds, X being substantially greater than Y, the system further including an open-center steering gear mechanism having inlet and outlet ports, the outlet port of the steering gear mechanism being in fluid communication with the inlet port of the pump, the steering gear mechanism being adapted to receive a fluid flow rate of Z over substantially the entire range of operating engine speeds, X being substantially greater than Z, said motor-valve apparatus comprising:

(a) housing means defining an inlet port, a primary outlet port for connection to the inlet port of the steering gear mechanism, and a secondary outlet port for connection to the inlet port of the pump;

(b) a positive displacement, fluid pressure actuated rotary device operably disposed within said housing means, said device being adapted to drive a fan, and defining expanding and contracting fluid chambers, said device having a displacement operable to provide a desired fan speed, at engine idle, corresponding to a fluid flow rate of approximately Y, and a peak fan speed corresponding to a fluid flow rate of approximately X;

(c) said housing means defining a fluid pressure port and a fluid return port communicating with said expanding and contracting fluid chambers respectively;

(d) said housing means defining an inlet passage, an outlet passage and a bypass passage communicating between said inlet and outlet passages, said inlet passage providing fluid communication between said inlet port and said pressure port, and said outlet passage providing fluid communication between said return port and said primary and secondary outlet ports;

(e) bypass valve means disposed in said inlet passage and being movable, in response to variations in a predetermined temperature condition, between a first position

substantially preventing fluid communication from said inlet passage to said bypass passage at a relatively higher temperature, and a second position permitting fluid flow from said inlet passage to said bypass passage at a flow rate which is at least a major portion of X at a relatively lower temperature, the bypass flow through said bypass passage and the return flow through said return port being recombined;

(f) flow control valve means disposed in said outlet passage and being operable to maintain a fluid flow rate of Z from said outlet passage to said primary outlet port over substantially the entire range of operating engine speeds and to communicate substantially all fluid flow in excess of Z from said outlet passage to said secondary outlet port.

11. Apparatus as defined in claim 10 wherein said bypass valve means includes valve positioning means comprising a liquid-solid phase change material.

12. Apparatus as defined in claim 10 wherein said bypass valve means includes valve positioning means comprising an electromagnetic coil.

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1. Document ID: US 20020135370 A1

L21: Entry 1 of 2 File: PGPB Sep 26, 2002

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INVENTOR-INFORMATION:

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US-CL-CURRENT: 324/318; 324/306

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2. Document ID: US 5932940 A

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TITLE: Microturbomachinery

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US-CL-CURRENT: 310/40MM; 257/414, 257/415, 290/52, 60/39.35, 60/804

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